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The preimaginal stages of *Striphnopteryx edulis* (Boisduval, 1847) (Lepidoptera: Eupterotidae)

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Abstract. The eggs, all larval instars and the pupa of *Striphnopteryx edulis* (Boisduval, 1847), the type and only species of the southern African eupterotid genus *Striphnopteryx* Wallengren, 1858, are described and illustrated, including the chaetotaxy of the first-instar larva. The salient characters of the larva and pupa are briefly compared with those of a few Asian genera of the family.

Key words. Eupterotidae, Striphnopteryginae, *S. edulis*, egg, larval instars, chaetotaxy, pupa.

INTRODUCTION

Striphnopteryx edulis (Boisduval, 1847) (Figs 1–6) is a large southern African species of Eupterotidae (monkey-moths) and the type and only species of *Striphnopteryx* Wallengren, 1858, the type genus of the subfamily Striphnopteryginae Wallengren, 1858, which currently includes 15 genera (Nässig & Oberprieler, 2008). *Striphnopteryx edulis* occurs from the south-eastern parts of South Africa north into Mozambique and eastern Zimbabwe (Pinhey, 1975) and is rather common in KwaZulu-Natal. No authentic descriptions or illustrations of its larva have been published, Boisduval's (1847: 600) account in the original description of the species "La chenille de ce grand *Bombyx* vit en societé sur un arbre des environs de Port-Natal; elle est noire, marqué de taches rouges. Les Cafres la mangent après l'avoir fait griller; c'est ce qui a fait donner à cette espèce le nom d'*Edulis*" evidently referring to the gregarious larvae of a species of Saturniidae, which are often eaten by local people there. The literature (Platt, 1921; Pinhey, 1975; Kroon, 1999) does, however, record both native and introduced host plants for the larva of *S. edulis* in South Africa, respectively *Cordia caffra* (Boraginaceae), *Tecoma capensis* (Bignoniaceae), *Acacia mearnsii* (Fabaceae) and *Bougainvillea* (Nyctaginaceae).

This paper describes and illustrates the egg, larva and pupa of *S. edulis*, including the chaetotaxy of the first-instar larva, from material reared in Germany from eggs obtained from a gravid female collected in South Africa. The descriptions enable a comparison of the immature stages of this taxon with those of a few Asian genera of Eupterotidae and thus contribute characters to an eventual reconstruction of phylogenetic relationships within the family.

MATERIAL AND METHODS

A gravid female of *S. edulis* was collected at light on 11 April 2007 by V. V. Z. in the Republic of South Africa, in the Ramsgate Butterfly Sanctuary (30°53'S 30°20'E, 45 m a. s. l.) located in the province of KwaZulu-Natal. Identification of the species was made by comparison with the holotype (Fig. 3) housed in The Natural History Museum, London, United Kingdom. From eggs laid by this female, larvae were reared on *Convolvulus* and *Calystegia* (both Convolvulaceae) to pupation in captivity in Germany by D. S. The morphological study of the preimaginal stages, including the illustrations, was carried out by S. N. P.

For the study of the chaetotaxy of the first-instar larva, specimens were preserved in 70–80% ethanol and cut longitudinally for rapid maceration (15–20 min) in 10% NaOH solution in a double-boiler. The head capsule was cut from the body using micro-scissors and the skin cleaned from tissues using a micro-brush. The skin was then washed in hot water and dehydrated and hardened with ethanol (sequentially through concentrations of 50%, 80% and 96%) before mounting in Euparal on a glass-slide under a cover-glass. The head capsule was treated in the same way, except that the cover-glass was supported by small pieces of glass to avoid undue pressure and distortion. Mandibles, labrum and labio-maxillary complex (Figs 25, 29, 30) were dissected from the head capsule and studied and preserved separately. Three first-instar larvae were subjected to this procedure.

The preparations were studied under a light-microscope and photographed using a Canon PowerShot A570 and an Olympus Camedia C-750 camera. Images were processed using Adobe Photoshop 7.0, and colour plates were prepared from scanned analogue and digital photographs using CorelPhotoPaint X3.

In the chaetotaxy of the larva, the nomenclature of Hinton (1946) is followed.

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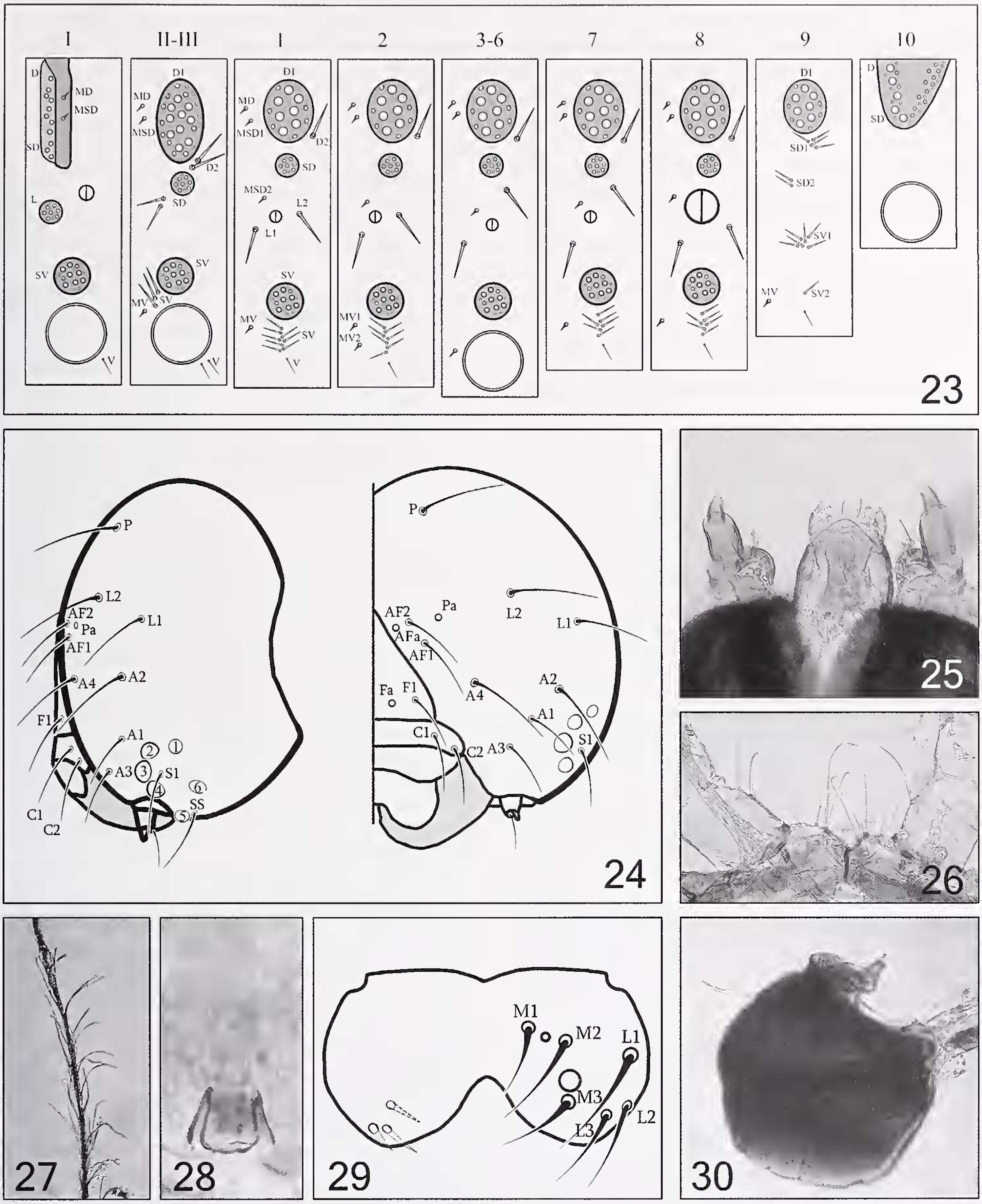
Figs 1–6. Habitus of *Striphnopteryx edulis* adults. **1**. male, South Africa, KwaZulu-Natal, Ramsgate Butterfly Sanctuary, reared specimen, upperside; **2**. ditto, underside; **3**. holotype male, BMNH; **4**. female, same data as 1, reared specimen, upperside; **5**. same male as in 1), newly eclosed, in resting posture; **6**. dark male, Zimbabwe (photo: Bart Wursten). (scale bar 10 mm).

Figs 7–22. Preimaginal stages of *Striphnopteryx edulis*. **7**. eggs; **8**. L1 shortly after hatching; **9**. L1 after feeding; **10**. anterior part of L1 in pre-moulting phase, showing bulging pronotal shield; **11**. L2 fixed in ethanol; dorsal, lateral and ventral views; **12–13.** L2; lateral and dorsal views; **14**. L3; **15**. L4; **16**. L5; **17**. L6; **18**. head of L6, frontal view; **19**. cocoon; **20**. pupa after eclosion; dorsal, ventral (head shield only) and lateral views; **21**. caudal end of pupa, ventral view, showing densely denticulate apex; **22**. same, less enlarged.



Figs 23–30. Structural details of *Striphnopteryx edulis*, L1. **23**. setal map of body segments; **24**. setal arrangement on head; **25**. labio-maxillary complex; **26**. fore legs showing fused coxae; **27**. plumose (?subprimary) seta; **28**. base of seta; **29**. setal arrangement on labrum; **30**. mandible.

Description of immature stages

Egg (Fig. 7). Hemispherical, of upright type, about 2.5 mm in diameter, dark yellow without distinct pattern, with flattened base, the micropyle situated in a small depression at the dorsal pole.

Larva. First instar (Figs 8–10) 5–9 mm long, with very long, white, pinnate primary setae; head (Fig. 24) shining dark brown to black with pale area around border of eyes and white vertex, orthognathous, hemispherical, without processes, vertex with small but distinct depression, frontal suture longer than that of vertex (epicranial index 0.76); ventral side of body greyish-white, dorsally and laterally dark grey, dorsally with a narrow, white median line interrupted at intersegmental borders, laterally with a somewhat weaker but otherwise similar line; pronotum narrow, black, transverse (Fig. 10); thoracic legs greyish-white. Second, third and fourth instars (Figs 11–15) dark brown dorsally and laterally, yellowish-brown ventrally; dorsal and lateral longitudinal lines bright yellowish-brown in 2nd but less distinct in 3rd and 4th instars (Figs 14–15); head shining reddish-brown with black frontal band, pronotum reddish; ventral surface darker reddish-brown; thoracic legs brown, prolegs pale reddish-brown; body densely covered with long, reddish, stiff, urticating setae grouped in sparse tufts, interspersed with longer, finer, ash-grey hairs. Penultimate (L5) and final instars (L6; Figs 16–18) dark brown, covered with long ash-grey hairs interspersed with abundant reddish- to dark brown, shorter urticating setae; head (Fig. 18), legs and prolegs reddish brown; hairs not grouped in tufts as in most other eupterotid genera but forming transverse bands. Procoxae connate at base (Fig. 26).

Pupa (Figs 20–22, 31). Subcylindrical, anteriorly and posteriorly rounded, 35–37 mm long, blackish-brown, surface shining; frontal shield elongate teardrop-shaped; mandibular sheaths very small and indistinct; sheaths of maxillary palps reaching fusion line between antennal sheaths, sheaths of fore and middle legs not touching distally, the former almost reaching distal parts of sheaths of maxillary palps; the latter 0.8x as long as those of forelegs; wing sheaths smooth and glossy but with fine transverse striae; abdominal segments also striate in posterior half, anterior half covered with small round depressions enlarged at intersegmental region; cremaster absent but apical surface densely denticulate (Figs 21–22), covered by larval skin inside dense, hairy and spiny cocoon (Fig. 19) spun under leaf litter on soil surface.

Chaetotaxy of first-instar larva

Head (Fig. 24): Frontal seta F1 slightly above pore Fa; AF2 and AF1 along upper half of frontal suture, AF2 slightly above AF1; clypeal setae C1 and C2 in typical position; setae of fore group (A1–A4): A3 above antenna, drawn level with C2, A4 near epicranial suture opposite to seta F1, A1 at most equidistant between A2 and A3, all three forming a direct line, A1 above stemma 3, level with A2; lateral seta L1 above stemma 4, level with AF2, L2 above antenna, level with apex of vertex; pore Pa near seta AF2, on line with AFa and AF2; single seta of the stemma group (S1) above stemma 4; SS1 behind stemma 5. Stemmata 2–4 arranged in regular semicircle, and 1 and 5 slightly apart from them, all similarly pigmented and apparently functional. Labrum (Fig. 29) generally rounded, anterior margin with deep median notch, with standard set of setae: M group forming a triangle, M1 near midline, equidistant between upper and lower margins, small pore between M1 and M2 and larger one between M2 and M3; L2 near lateral margin, close to L3. Mandibles (Fig. 30) adentate, molar surface excavate, with concave edge, with two setae, the larger one twice as long and more basal. Body (Fig. 23): Setae dimorph, either stout, long, needle-shaped or fine, long, hair-like; generally situated on sclerotized verrucae or smaller shields, stout ones in centre and fine elastic ones at periphery; subprimary setae thin, elastic and plumose (Fig. 27); bases of primary setae in deep sockets (Fig. 28).

D-group. D1 and D2 on T1 on pronotal shield but completely obscured by subprimary setae; on T2–T3 and A1–8, D1 on large spherical verruca with numerous subprimary setae; D2 isolated, closely behind D1 verruca but on D1 verruca on A9, double on T2–T3; on A10 together with SD group on triangular anal shield, anteriorly mostly shorter, thick, but caudally longer, finer.

SD-group. On T1 on pronotal shield together with D; on T2–3 and A1–8 on small spherical verruca together with numerous subprimary setae; on A9 arranged into two clusters, upper SD1 comprising 3–4 setae below D verruca and lower SD2 setae. On A10 together with D-group on the triangular anal shield.

L-group. On T1 on small spherical verruca together with numerous subprimary setae; on T2–3 two separate setae near SD verruca; on A1–2 also two separate setae, L1 anteroventrally and L2 posterodorsally of spiracle; similar on A3–7 but more widely spaced; on A8 both L1 and L2 below spiracle, which is almost 4x larger than on other segments; on A10 absent.

SV-group. On T1 on large verruca with numerous subprimary setae, directly above procoxa; on T2–T3 on similar verruca but with some small subprimary setae between verruca and coxa; on A1–2 and A7–8 in similar arrangement; on A3–A6 on verruca together with some subprimary setae; on A9 arranged in cluster together with some subprimary setae but not on verruca, except a single SV2 lower, close to V-seta; on A10 absent.

V-group. Single V seta on each side of T1–T3, A1–A2 and A7–A9 in standard position; on T2–3 sometimes double seta; on A3–A6 and A10 absent.

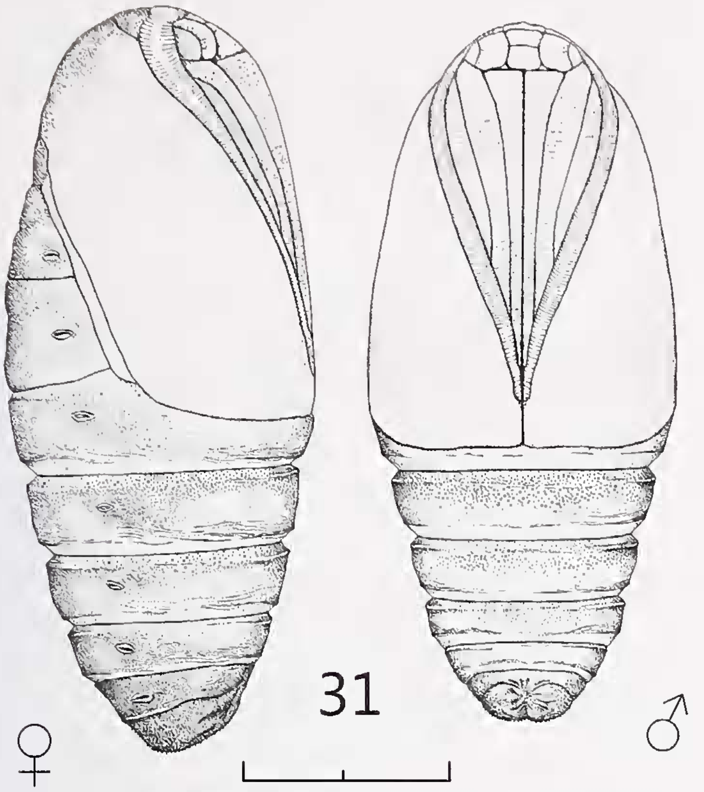


Fig. 31. Pupa of *Striphnopteryx edulis*, lateral (female) and ventral (male) views (scale bar 10 mm).

Some very short micro-setae are also present: mD (MD) and mSD (MSD) close together in front of D1 on T2–T3 and A1–A8, on A1–A8 mSD2 anterodorsally of spiracle; mV group below SV, on T2–T3 in front of coxa, on A1, A2 and A7–A9 in front of SV, on A2 double, on A3–A6 in front of prolegs.

DISCUSSION

As typical of the family, the procoxae of the larva are connate. Lemaire & Minet (1999: 330) considered this character as an autapomorphy of the family, but Oberprieler et al. (2003: 109) reported free procoxae to occur in some genera of the *Phiala* section of Striphnopteryginae. The insertion of the primary setae in deep sockets (Fig. 28) appears to be an unusual and perhaps phylogenetically significant character, as it also occurs in other eupterotid genera studied (*Apha* Walker, 1856, *Palirisa* Moore, 1884, *Pseudojana* Hampson, 1893, *Hoplojana* Aurivillius, 1901). However, the insertion of the primary setae needs to be studied more closely in other eupterotid genera and also in other bombycoid families.

Some other characters possibly can be considered diagnostic for the genus *Striphnopteryx:* in the larva, the molar surface of the mandible is shovel-shaped and untoothed; the SV-verrucae on segments A3–6 are well developed (contrary to the condition in *Pseudojana incandescens* – see Pugaev & Zolotuhin 2011); the bases of SD-setae are transformed into strong, sclerotized verrucae with a large number of subprimary setae (in *Palirisa* – see Pugaev & Thieu, 2011 – and in *Pseudojana* they are represented by a single strong seta only); all groups of setae have subprimary setae admixed; in the pupa, a typical cremaster is absent, but the terminal segments of the abdomen are densely denticulate (as in *Pseudojana incandescens*; in *Palirisa salex* hooked cremastral setae are present); the mandible sheaths are small and indistinct; and the sheaths of the maxillary palps reach the fusion line between the antennal sheaths (in *Pseudojana* the antennal sheaths do not touch each other distally).

Some of these characters, as well as others not mentioned above, may possibly prove to be suitable to distinguish Striphnopteryginae from the (probably closely related) Eupterotinae, but this remains speculative until the immature stages of many more genera are carefully studied and compared.

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